USB RF Mouse with nRF24L01

nRF24L01 is a single chip RF-transceiver intended for applications in the 2.4 GHz ISM band.

AT89STK-05 is a high-performance Flash version of the 80C51 single-chip 8-bit micro controllers with full speed USB functions.

This application note describes an application using nRF24L01 and AT89STK-05: **USB RF Mouse**.

The following document is important to read prior to this application note (available on www.atmel.com):

nRF24L01 software driver for C51 microcontroller:

AT89STK-05 software driver description to control nRF24L01 device.

References

AT89STK-05 data sheet (available on www.atmel.com)

nRF24L01 data sheet (available on www.nordicsemi.no)

Acronyms

USB:
Universal Serial Bus

ISM:
Industrial, Scientific and Medical (radio spectrum)

USB RF Mouse

Application Note

7650A–USB–05/06

RF Mouse Overview

The transmitter board is composed of an nRF24L01 controlled by an AT89STK-05.

The mouse contactors are connected on AT89STK-05 IOs.

The transmitter sends mouse info via the RF part.

The power supply of the transmitter board comes from a battery.

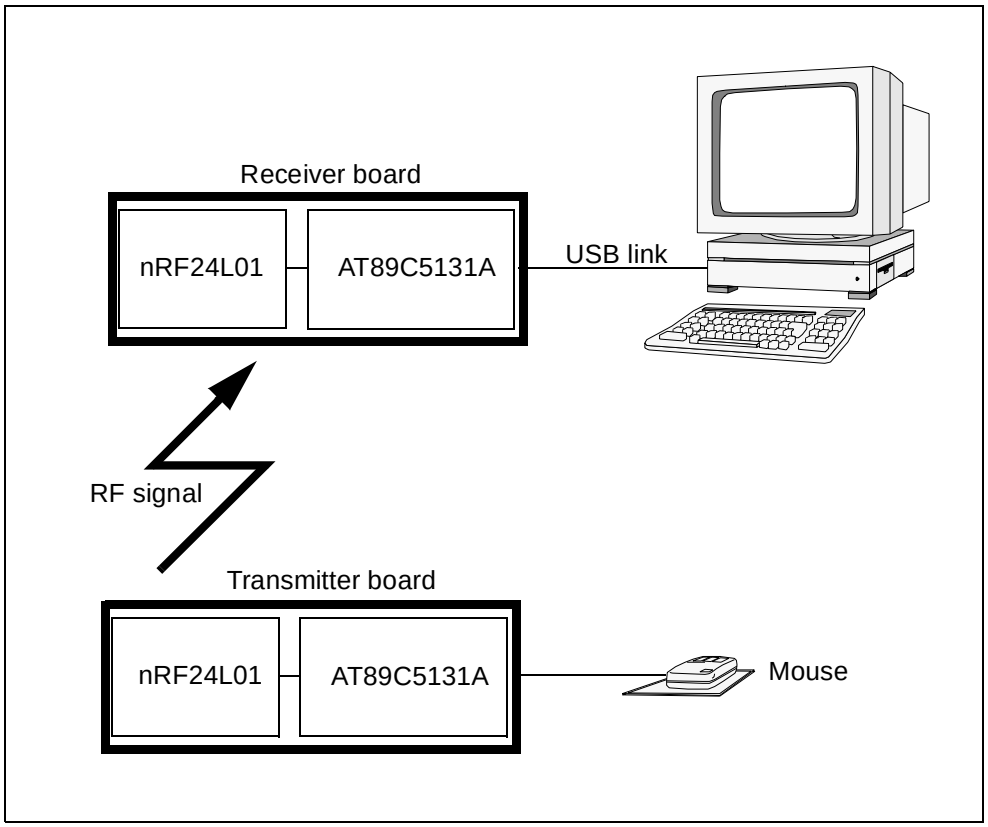
The receiver part decodes the mouse info.

AT89STK-05 is connected to the PC with an USB link.

The USB enumeration is “HID mouse”.

The power supply of the receiver board comes from USB (5V to 3V with a linear regulator converter).

Figure 1. Typical Application



The nRF24L01 reference module is connected to AT89STK05 demo board (see www.atmel.com).

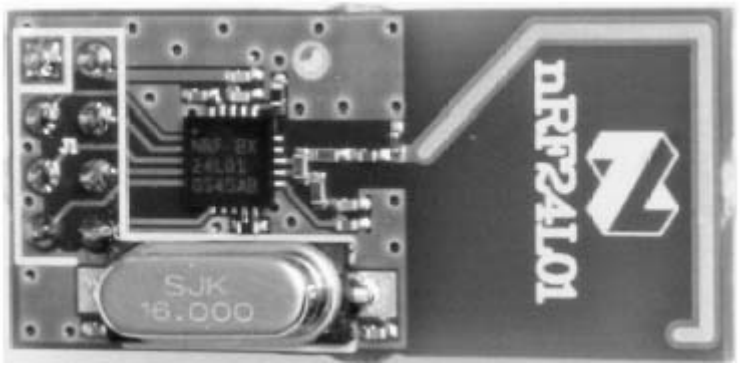
nRF24L01 Reference Module

nRF24L01 reference module is a complete RF-Module, designed to evaluate the RF IC performance and develop custom specific applications.

The RF-Module is included into the nRF24L01-EVKIT but is also available seperately.

Two RF-Modules are used, one for the transmitter part and one for the receiver part.

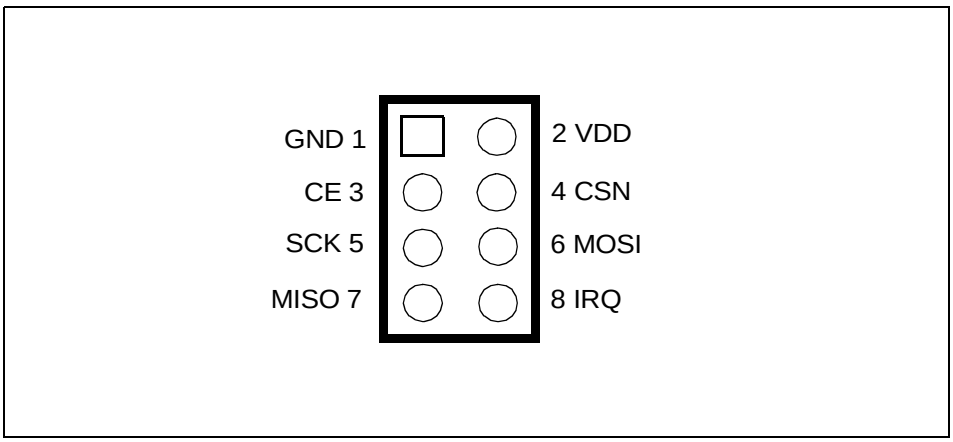
Figure 2. nRF24L01 Reference Module



nRF24L01 is soldered on the board. The antenna is designed on the board. All the signals to control nRF24L01 are on the 8 points connector.

All the documents concerning the board are available on www.nordicsemi.no.

Figure 3. Reference Module Connector (component side)

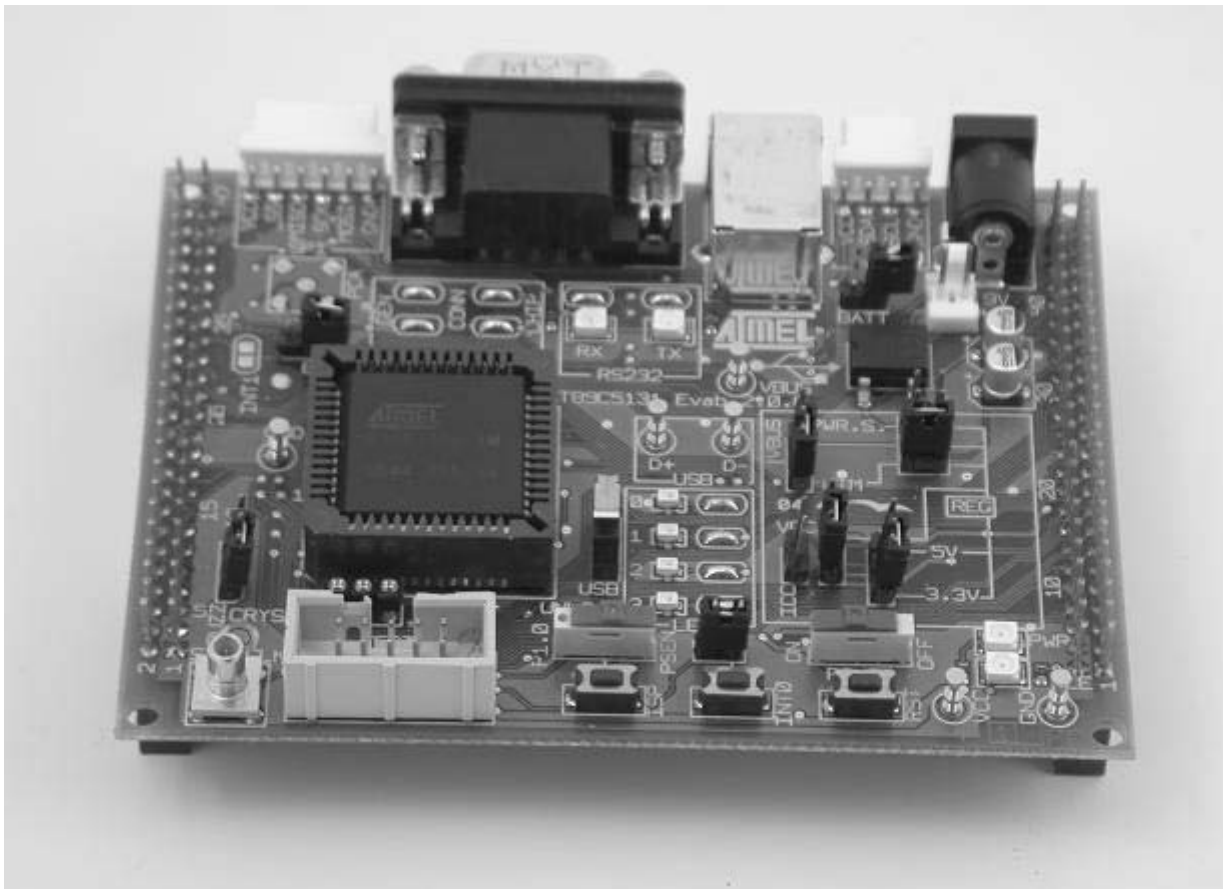


AT89STK-05 Starter kit

AT89STK-05 starter kit is connected on USB bus. AT89C5130 (16K) Flash or AT89C5131 (32K) Flash can be plugged on the PLCC Flash socket depending on the application code size. The power supply of the starter kit comes from USB (5V). The microcontroller can directly run from the USB voltage but the RF device operates from a lower voltage and the C51 has to be powered from the same voltage.

The starter kit allows to operate at different volatage levels and from different sources. For this demonstration it shall be configured at 3.3V in bus power mode as shown in Figure 4.

Figure 4. AT89STK-05 Starter kit



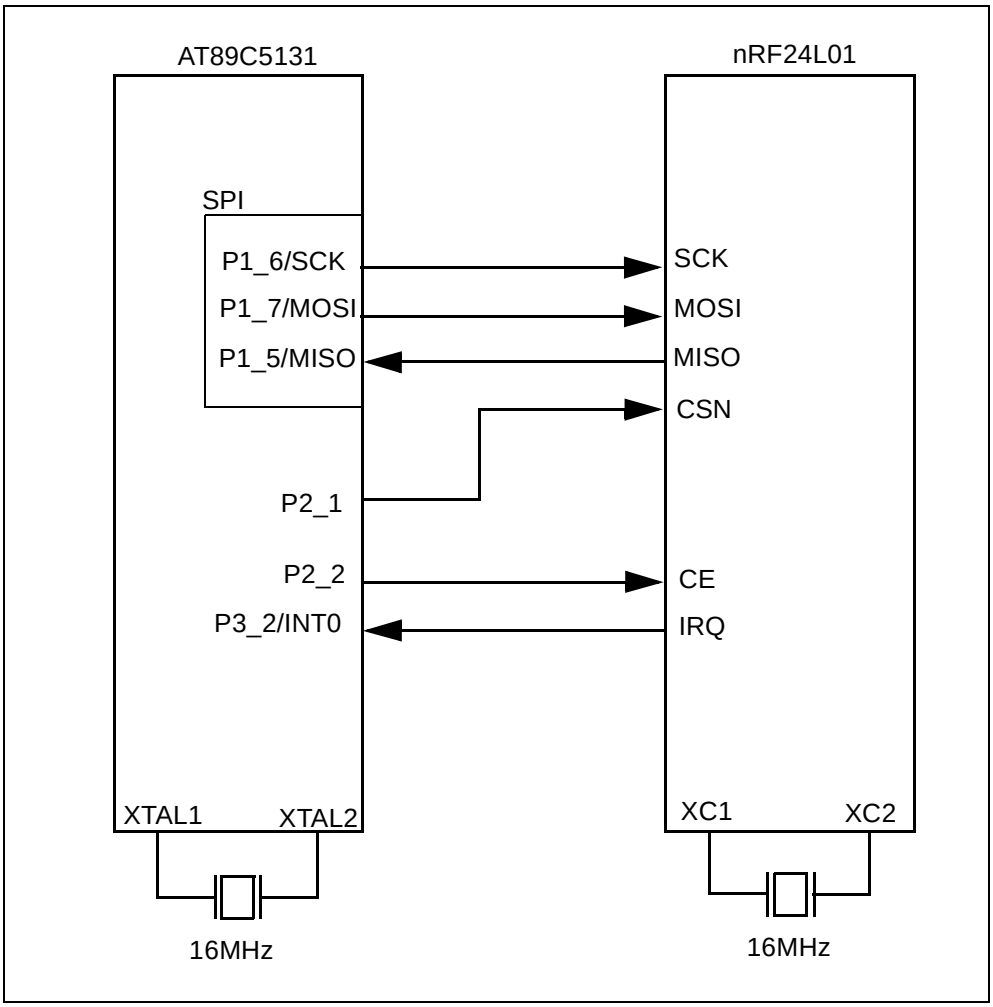
The left connector (J5), the right connector (J6) and the SPI connector (J2) provide the required signals to provide the nRF24L01 module

Hardware Connections

AT89C5131 hardware SPI bus is used to configure nRF24L01. The SPI bus is also used to send /receive data via the RF.

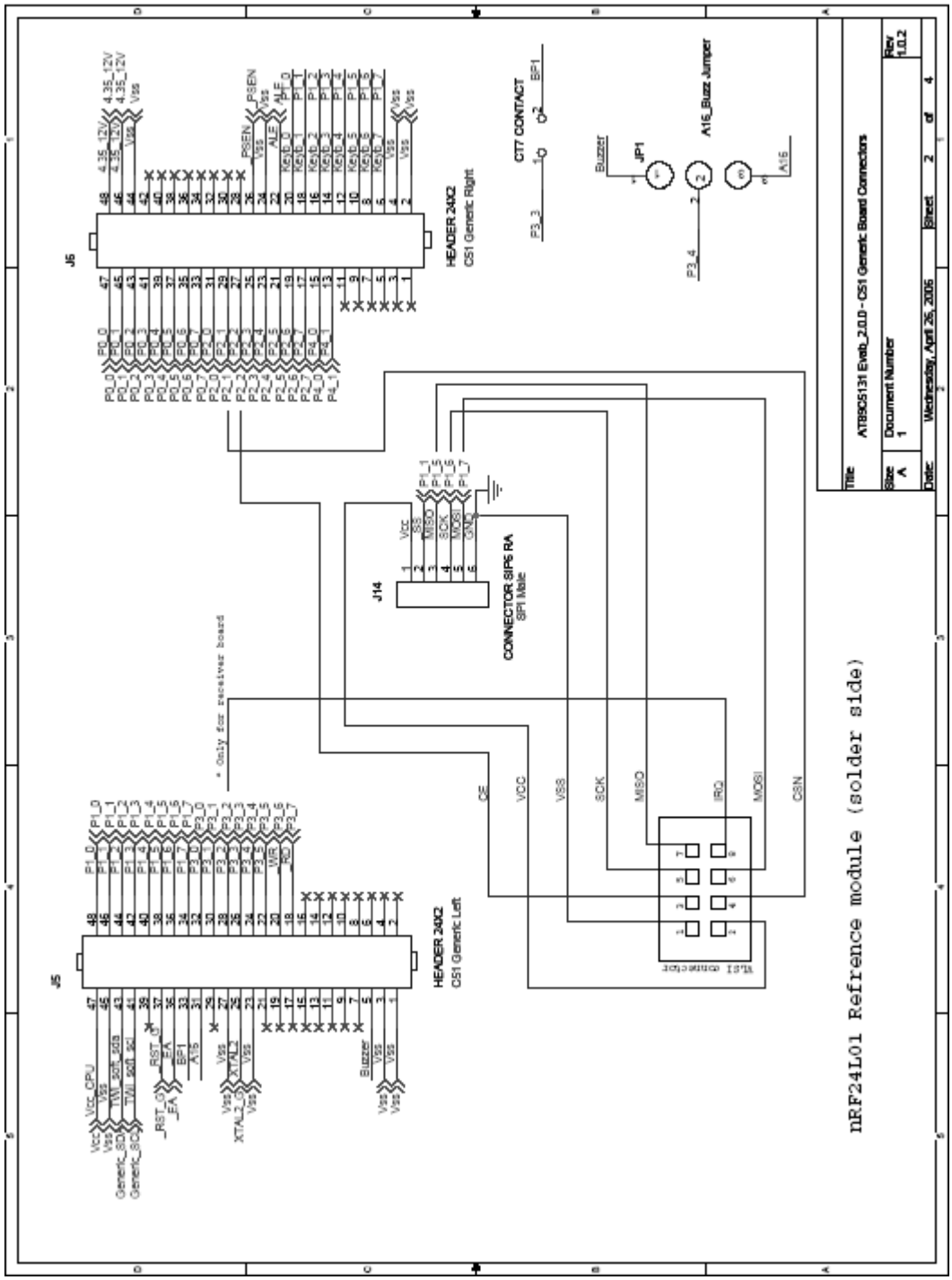
The transmitter and receiver hardware connections are identical.

Figure 5. AT89STK-05 and nRF24L01



Note: Both ICs can share the same crystal if placed on the same PCB.

Figure 6. Connections between AT89STK-05 and nRF24L01 boards



RF Mouse Software

The RF mouse software is divided in two parts:

- transmitter part
- receiver part

Transmitter part

The transmitter part controls the signals from the mouse and send RF data. The default parameters are programmed for data pipe number (Pipe 0) and for frequency channel (RF Channel 2). The TX Payload command is used to send the data byte with mouse information.

In the config.h file, the flag “nRF24L01_TRANSMITTER” must be defined.

The data byte contains on each bit a mouse status (left, right...). This byte is described below in Table 1.

Table 1. Mouse Status

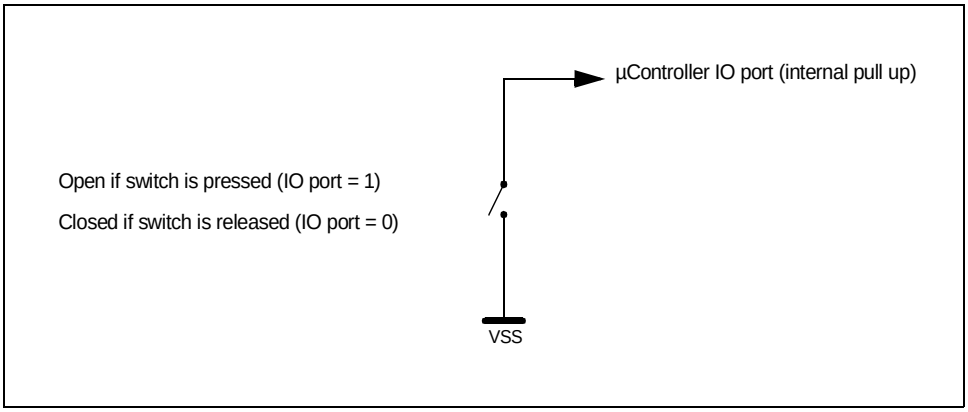
Bit number	Value
7	Unused
6	Unused
5	Cleared if LEFT CLICK pressed
4	Cleared if RIGHT CLICK pressed
3	Cleared if LEFT pressed
2	Cleared if RIGHTpressed
1	Cleared if DOWN pressed
0	Cleared if UP pressed

The mouse switches are connected to standard IOs of AT89STK-05. Table 2 describes the hardware connections between the mouse and the AT89STK-05.

Table 2. AT89C5131 IOs Description

Mouse switch	AT89C5131pin number
LEFT CLICK	P3_3
RIGHT CLICK	P1_3
LEFT	P3_7
RIGHT	P4_0
DOWN	P3_6
UP	P3_5

Figure 7. Description of Mouse Switch Connection



A message is sent if an event appears on the mouse (press or release).

When a switch is pressed, a message is sent to the receiver part.

When a switch is released, a message is sent to the receiver part.

The result of pressing a button is only two messages, whatever the duration of the press.

Receiver Part

The receiver part controls the USB link (HID mouse enumeration), the reception of RF data and the decoding of data protocol.

The software manages all the mouse movements even diagonals.

In the config.h file, the flag “nRF24L01_RECEIVER” must be defined.

Each polling period, the embedded USB task sends a message to PC with the mouse status. This message contains 4 data bytes:

- usb_mouse_report[0]
- usb_mouse_report[1]
- usb_mouse_report[2]
- usb_mouse_report[3]

Figure 8. usb_mouse_report

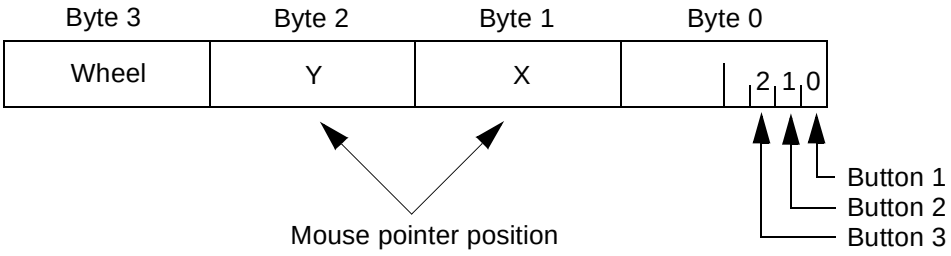


Table 3. usb_mouse_report[0]

Bit number	Value
7	Unused
6	Unused
5	Unused
4	Unused
3	Unused
2	Set if Middle button Not implemented
1	Set if Right button
0	Set if Left button

Table 4. usb_mouse_report[1]

Byte value	Value
0xFD	Move left
0x03	Move right
0x00	Move stop

Table 5. usb_mouse_report[2]

Byte value	Value
0xFD	Move up
0x03	Move down
0x00	Move stop

Table 6. usb_mouse_report[3]

Byte value	Value
1	Scroll up Not implemented
0	Scroll reset Not implemented
-1	Scroll down Not implemented

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Literature Requests
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7650A–USB–05/06